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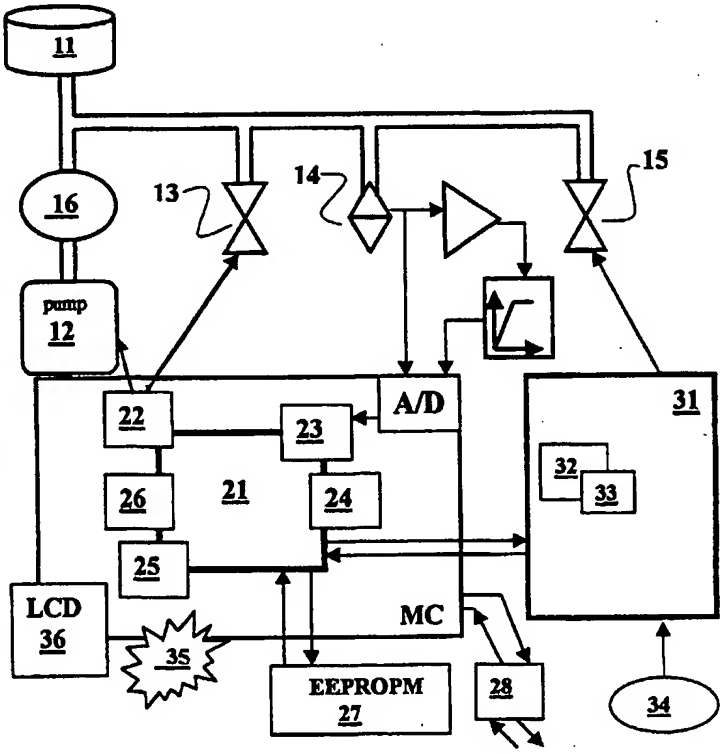
(54) Title: A BLOOD PRESSURE MEASURING APPARATUS



(57) Abstract: The subject matter of the invention is a blood pressure measuring apparatus (10) which serves to control and register regularly blood pressure during 24 hours or for a longer period of time, the mechanic part of said apparatus contains a measuring cuff (11) and a motor-driven pump (12), a pressure sensor (14) a discharge valve (13) and a safety valve (15) pneumatically connected to the cuff (11); the electronic part of said apparatus electrically connected with controlling connections to the motor-driven pump (12), discharge valve (13) and the safety valve (15) and a sensing connection to the output of pressure sensor (14). The characteristic feature of the apparatus according to the invention is that it contains a program controller (21) and a supervising unit (31), a controller of mechanical part (22), a signal receiving and processing unit (23), a storage unit (27), an evaluating unit (24), an arithmetic unit and a pressure allocating unit are connected to the program controller (21), and an internal clock (32), a power supply unit of clock (33) and optionally an event display (34) are connected to the supervising unit (31).

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A BLOOD PRESSURE MEASURING APPARATUS

The field of the Invention

The subject matter of the invention is a blood pressure measuring apparatus for long-lasting regular measurement of blood pressure, the mechanical part of the apparatus includes a measuring cuff a motor-driven pump with a pressure sensor, a discharge valve and a safety valve mechanically coupled to it, the electronic part is connected electrically to the motor-driven pump, to the measuring valve and the safety one in a manner to control them and to the output connection of the pressure sensor.

The Prior Art

The portable blood-pressure measuring apparatuses and those for home usage have been developed for the purpose that the blood-pressure measurement should be not an episodic examination, but the examined person could perform it during his real life in different situations and provide the physician with reliable data, which are eligible for evaluation. The clinical measurements are performed expertly and using a high quality equipment, nevertheless they have a disadvantage, that the patient is under unusual circumstances, in the environment of a hospital which causes stress in the majority of cases (the so-called „effect of white cloak") and it leads to false results of measurement. The number of patients treated against high blood pressure is higher by 20 to 25 % than the real one by this reason. The results of the treatment with medicaments cannot be really recognized on the basis of occasional measurements by similar reasons. The modern portable blood pressure measuring instruments with cuffs being permanently held on the arm of patient which turn on automatically themselves at the points of time programmed by the physician. An instrument of such type can be applied for a series of measurements with duration not longer than 24 hours. When a measurement program of several weeks is effectuated, the apparatus notifies the patient with light or sound signal to the point of time when he should take the medicament and begin the measurement

of blood pressure. Having put the cuff on, the patient begins the measurement. The main requirements to the portable instruments are the smallest possible dimensions, weight and electric power consumption It is required furthermore from all blood pressure measuring instruments especially the portable ones that they should exclude the „noise caused by muscular movement" (the so-called artifacts) from the measured values, and they should not store the erroneous values. A characteristic example of apparatuses of such type known in prior art is described in the US patent No. 4,367,751. This apparatus contains a three-channel noise filter in addition to the usual components (cuff, pump, discharge valve etc.) of blood pressure measuring instruments, which filter measures rhythm of impulses, used pressure level and first differential quotient of the impulses taken by time. The filtration of disturbance signals, prevention of output of the erroneous data and repetition of measurement on error conditions are performed on this basis. The advantageous feature of the described apparatus and the similar ones is that they are battery powered portable apparatuses, which provide not only an episodic result of measurement, but an authoritative image about a period of a day or week by means of the collected data set.

Nevertheless, the disadvantageous feature of these apparatuses is that they correct the errors by multiple repetition of the measurements, so their power requirement is relatively high by this reason. This feature is disadvantageous for any portable apparatus on one hand, and the measurements are time consuming on the other hand, which is uncomfortable for the examined person. That is why some people endeavor to avoid the measurement, which decreases the value of results, because the series of data can become unfit for evaluation. Another disadvantage is that the difficulties of survey and time consuming evaluation of the big quantity of data can constitute trouble for the considerable number of practicing physicians who perform routine work. The elimination of erroneous results or the requirement of oversized storage capacity can make the apparatus more expensive in several particular cases, which can hinder widespread application and effective improvement of medical services.

The Disclosure

The purpose of present invention is to develop a cheap, reliable blood pressure measuring apparatus, having small weight and eliminating the characteristic faults described above and known from the present state of art.

We recognized, that the said requirements, i. e. required number of measurements, reliable data, the possible smallest inconvenience to the examined person and the possible best assistance to the physician's work can be fulfilled with a construction and a structural arrangement, wherein several units function in synchronized mode within a coordinated system of pneumatic and electronic components. The control of apparatus, processing of results of measurements and elimination of erroneous results can be performed simultaneously. We recognized that the time of the individual measurements become shorter. Using a portable apparatus, the number of measurements can increased and the weight of apparatus can be decreased primarily in consequence of decreased dimensions of required power supply unit. Using an apparatus at home during an intensive control (so-called IC) the short time of measurements and the quick replies can improve the comfort of the examined person. We recognized furthermore that the inconvenience caused by cuff can be considerably decreased if a measurement is performed even during inflation of the cuff, which provides data fit to evaluation, instead of the usual method with stepwise reduction of pressure, as the latter involves several repetitions, as it is known. An airbag acting as buffer and inserted before the motor-driven pump enables this measurement, as it eliminates the disturbance caused by the pump to the sensor.

A further recognition which underlies the invention is that the electronic units based on arithmetic relations developed by us eliminate the artifacts simultaneously with the procedure of measurement and they enable to store only results of measurements instead of raw data without loss of information. The reduction of storage requirement makes the apparatus cheaper and decreases the power consumption.

Our inventive recognition enables the mechanic and pneumatic devices to work shorter time than in known apparatuses and any return to previous pressure levels caused by errors can be either completely eliminated or minimized during a measurement.

Our solution is a blood pressure measuring apparatus based on our above mentioned inventive recognitions, which is applicable for continuous control and registration of blood pressure during 24 hours or for any longer period, the mechanical part of said apparatus consists of a measuring cuff, a pneumatically coupled motor-driven pump, a pressure sensor, a discharge valve and a safety one, furthermore its electronic part is connected electrically to the motor-driven pump, to the discharge valve and to the safety one in a manner to control them, and to the output connection of the pressure sensor. The characteristic features of the apparatus are that it is equipped with a program controller and a supervisor unit, a controller of mechanic part, a signal receiving and processing unit , a storage, a unit evaluating of results, an arithmetic unit and a pressure allocating unit are connected to the program controller, and an internal clock with a power supply unit and optionally an event display unit are connected to the supervisor unit.

The apparatus according to invention can be advantageously characterized by that the program controller, the signal receiving and processing unit, the unit evaluating the results, the arithmetic unit and the pressure allocating unit are advantageously embodied in a common micro-controller.

The apparatus according to invention can be also characterized that an airbag acting as puffer is included between the motor-driven pump and the cuff within the pneumatic system.

Furthermore, the apparatus according to invention can be advantageously characterized that it is equipped with a multifunctional event display unit.

It is another advantageous feature of the apparatus according to invention, that it is equipped with a LCD display and/or a sound signal output unit.

One of advantageous embodiments of the apparatus according to invention can be characterized by, that the apparatus contains an automatic controller of the voltage of the power supply unit.

The invention is described below in details with help of attached drawings without limitation of applicability of the invention nor the scope of protection claimed to the examples of embodiment.

Drawings:

Figure 1 The structural block-scheme of an advantageous embodiment of invention.

Figure 2 The schematic diagram of the program controller shown on the Figure 1 and the attached units.

The blood pressure measuring apparatus according to invention consists of a cuff 11, which should be fastened onto arm of the examined person, a motor-driven pump 12 pneumatically connected to it, a discharge valve 13 and a pressure sensor connected to the pneumatic system. There is another valve, a safety one included to the pneumatic system, too. An electronic part is connected to the described pneumatic part of apparatus (see Figure 1). The central unit of said electronic part is a program controller 21, to which the other units are connected electrically These units are as follows: a controller of mechanical part 22, the output connections thereof control the starter switch of measuring pump 12 and open the discharge valve 13; a signal receiving and processing unit 23, the input connection thereof is connected with the output of pressure sensor, a pressure allocating unit 26 controlled by the program controller 21 and one of its input connections is connected to output of a storage unit 27, an arithmetic unit 25 also controlled by the program controller 21, with one of inputs connected to output of the storage unit 27 and finally the evaluating unit of results of measurements 24 being electronically connected with the program controller 21 and the storage unit 27 ((see Figure 2). A supervising unit 31 belongs also to the electronic part, with its controlling

output connected to the opening mechanism of the safety valve 15 and is in „hand-shaking" connection with the program controller 21. An internal clock 32 provided with a power supply unit 33 is connected to the supervising unit 31. The apparatus can be connected through a PC connection 28 to a personal computer to perform an input/output data transfer. An electric power supply unit is also part of the apparatus, which is not shown for the sake of simplicity. The signal filtering and digitizing units are shown outside of the signal receiving and processing unit 23 for the higher clarity, they are, however parts of said unit.

The embodiment according to Figure 1 is equipped with a LCD display 36 and its driver and a sound signaling device 35. An event switch 34 is an unit of exceptional importance of the apparatus, which serves for the examined person.

The power supply unit of the apparatus consists of 4 cells of AA size or advantageously a NiCd accumulator battery. The input of built-in voltage stabilizer is connected through a circuit-breaker to the power supply unit. The stabilizer of output voltage about 4.1 V furnishes the supervising unit 31, LCD and clock power supply unit 33 with electric power. The power supply unit of clock 33 is a tablet battery cell. The units of higher power consumption (the motor driven pump 12, discharge valve 13 and safety valve 15) are furnished with electric power also through a circuit-breaker without stabilization. The controller of mechanic part 22 controls the motor-driven pump 12 through a switching circuit consisting of transistors. The controller of mechanic part 22 controls the discharge valve 13 through power amplifiers. The pressure in the system is transformed into electric signal through pressure sensor 14 by means of a piezoresistive pressure sensing bridge circuit. The bridge circuit is powered by a current generator. The output signal of pressure sensing bridge circuit i. e. the oscillation pressure waves are amplified by an AC-connected amplifier and filter stage then digitized by a built in AD converter in the signal receiving and processing unit 23. The stationary equilibrium of the bridge

circuit is set by choice of corresponding resistors. The amplification is set by a resistor in accordance with sensitivity of the pressure sensor.

The storage unit 27 used for storing the program of measurement and results thereof is expediently an EEPROM. The storage unit 27 is capable to store results of more than 600 measurements under normal conditions. The program controller 21 transfers data (writes and reads content) into storage unit through a simulated bus of 12C type, but the writing should be enabled also through the DWP line controlled by supervising unit using instructions issued by supervising unit 31.

The program controller 21 is applicable for measurement of voltage of the power supply unit through a potential divider built up of resistors. It writes the voltage value onto LCD display on receiving the corresponding instruction and enables to control the charge of working power supply unit. An integrated stabilizer monitors the input voltage through a potential divider and if the voltage decreases under a safety limit the stabilizer transmits immediately a signal to the supervising unit 31. Such cases can occur at turning on of a valve or by starting of the motor in normal operation. The supervising unit interrupts the current measurement in such case and sets the program controller 21 and the units connected to it into normal position. An error code is stored as result of the current measurement and a „low battery voltage" (scored out symbol of battery) appears on the LCD display 36.

The apparatus can be connected to an IBM compatible personal computer (PC). The program controller 21 can communicate with the user's computer through a serial line in half-duplex mode. The communication can be initiated always by the computer. Signals sent by computer enter to the receiving amplifier then to shaping circuit. The reconstructed asynchronous serial signals are received and interpreted by program controller 21.

The event signaling device 34 is essentially a multipurpose push-button which serves for the examined person, who is the operator of the apparatus at the

same time. The usage of event signaling button 34 is accompanied with a low sound signal during the function of apparatus. The portable apparatus should not be turned on, because it begins the measurements automatically after the physician's program has been loaded. The home IC apparatus is turned on by the patient for each measurement. The event signaling device 34 is a multipurpose push-button which have the following functions: The patient can begin an extraordinary measurement pressing the button for a **short** time with a portable apparatus. Each measurement is started by this way when a home apparatus (for IC) is used. The apparatus stores the result of each blood pressure measurement and its time point, and an „event indication" if it intervenes out of planned time points. The extraordinary measurements can be caused by a dizziness, a sudden pain (angina pectoris or headache), palpitation etc. When the event signaling button 34 is held down for **10 seconds** and released after the two horizontal lines occur on the display in stationary state of an automatic apparatus, it is turned off. The automatic apparatus does not return to stationary state in this case, but if the button is held down any more, it returns to the stationary state. The apparatus turns on if the button is held down for at least three seconds. The blood pressure measurement being in progress can be interrupted by pressing the button, so the pressure in the cuff 11 can be decreased to null. This interrupt concerns only the actual measurement, it does not affect any other measurement. The said interrupt is registered by program controller 21 in the list of measurements in storage 27. When an „extraordinary" measurement is started in the stationary state of apparatus, all segments of LCD display 36 becomes visible. The operability of individual segments and of the whole LCD display 36 can be controlled by this way. The time point of any event deemed important by the patient but not requiring extraordinary blood pressure measurement can be registered in memory 27 by means of **two short** adjacent pressing of event signaling button 34. The differentiation of the values measured in the day and night is important for automatic apparatuses. The patient registers the point of time when he goes to

bed in the evening and that when he gets up in the morning by holding down the button for at least five seconds.

The function and usage of the apparatus according to invention can be understood on the basis of the tasks of blood pressure measurement and evaluation of its results. The traditional blood pressure measurement proceeds as follows: The cuff 11 is fastened onto arm of the examined person. The pressure in this cuff 11 is continuously raised by motor-driven pump up to the point when the impulses of heart-beats decreases under the sensitivity threshold of sensor 14, i. e. they cannot be sensed any more. This pressure (p_s) is read off. Then the pressure is decreased by means of the discharge valve in cuff up to the point when the heart-beats can be sensed and this pressure (p_d) is read off again. Using a portable automatic apparatus, the cuff 11 is continuously (during 24 hours) on the patient's arm, and the apparatus turns itself on and measures the blood pressure in the points of time according to program loaded by the physician into apparatus. Using a so-called room IC device the examination can proceed even several weeks, the cuff 11 is not permanently on the patient's arm by this reason. When the point of time of a measurement comes, the apparatus according to invention issues a signal, the examined person puts the cuff onto his arm and begins the measurement by turning on the apparatus. This signal can mean the point of time of taking the medicament and also the measurement thereafter. To ensure a valid measurement, the cuff should be over the arteria brachialis as exactly as possible. The lower border of cuff should be over the elbow by at least 2-3 cm.

The apparatus functions after manual or automatic start as follows: It measures the amplitudes a as the ones of oscillation of heart-beats superposed onto actual pressure (p-value) in cuff at each pressure set by steps of 10-15 millimeters of mercury within the range between the limits going from the upper to the lower one. The value of a grows continuously from the first pressure giving a first amplitude fit for evaluation up to a maximum one, it decreases thereafter, because the pressure can be less sensed by sensor 14 in consequence of the

loosing of cuff 11 as the pressure decreases, so the value of **a** decreases step by step. The values of p_s and p_d can be calculated from the values of amplitudes belonging to the pressure range above the given **p** belonging to the peak of amplitude and the amplitude values belonging to the range below it respectively. A parabola fitting to series of **a** within the measurement range is searched according to the convention received for our method. The peak of amplitudes [a_{cs}] is defined, then points pertaining to ordinates of 0.8 a_{cs} and 0.5 a_{cs} are marked on the part above a_{cs} of said curve, and the points pertaining to ordinates 0.85 a_{cs} and 0.55 a_{cs} in the part below a_{cs} are marked. A straight line is lead through each pair of points. The abscissa pertaining to the ordinate 0.5 a_{cs} on the first one defines the systolic pressure (p_s) and the abscissa pertaining to the ordinate of 0.75 a_{cs} on the second one defines the diastolic pressure (p_d). Any a_i value measured at a given p_i can be accepted on the basis of three values of **a** which deviate at most by 25 %, have values higher than 3 millimeters of mercury and are measured within 7 seconds using at least 4 impulses. Furthermore, the said a_i measured at p_i can be accepted if it is between the values of **a** measured before and after it or in a special case it is higher than both neighboring ones, but never lower them. If any of these conditions is not accomplished, the apparatus abandons measurement at given p_i and returns to it later. If a measurement is completed without success or interrupted by the patient pushing the button, the apparatus stores an error code in storage unit 27 to define the cause of failure. These codes are loaded into computer PC when data are read in and they can be marked in the table of results of measurements. The knowledge of said codes helps the user or service station to discover causes of problem.

The usage and function of apparatus are as follows:

The physician who performs treatment loads the points of times of blood pressure measurements as plan of examination into storage unit 27 10 through connection 28 of apparatus. The apparatus 10 fastened onto the body of examined person is in stationary state up to the moment when the point of time

for measurement is reached. The supervising unit 31 compares time data provided by internal clock 32 energized by clock power supply unit 33 with the point of time of the forthcoming measurement according to stored plan of examinations. If they are equal, it issues a start signal to the program controller 21, which starts the blood pressure measurement. The apparatus for home IC is also in stationary state and issues a sound and/or light signal notifying the patient to take medicament and to begin measurement when a programmed point of time is reached. The program controller requests the next pressure value from pressure allocating unit 26 to establish pressure in cuff 11. The pressure allocating unit 26 calls limit values of range of measurements relating to the examined person and the value of systolic pressure increases by 30 millimeters of mercury. If no measurement have been performed during the actual examination, i. e. the data called from storage unit 27 is null, the pressure allocating unit 26 loads values of 80 and 155 millimeters of mercury as limits of measurement range into storage unit 27 and loads 155 millimeters of mercury as next pressure value. The controller of mechanic part 22 closes the discharge valve 13 and establishes the pressure pi received from the program controller 21 in the cuff 11 by starting the motor-driven pump 12. The output signal of the pressure sensor 14 enters into signal receiving and processing unit 23, which differentiates the oscillation pressure values „p" and $\underline{a}$ then forwards them to program controller 21. The value „p" is pressure at the first stage of blood pressure measurement a is pressure amplitude of impulses received according to heart-beats. The measurement evaluating unit 24 checks whether at least 4 impulses have been received within 7 seconds defined as condition and at least 3 measured $\underline{a}_i$ differs less than 25 % at the given p_i stage. If the conditions are accomplished, it stores the conjugate pair of values „p_i" and $\underline{a}_i$, otherwise stores the failed measurement at „p_i". The control returns then to program controller 21, which starts the setting of next pressure stage „p_{i+1}" through pressure allocation unit 26. The pressure allocation unit 26 check if a successful measurement was accomplished at the previous „p_{i-1}" stage (i. e at higher pressure stage) If not, it returns to that stage and gives this pressure in

cuff to controller of mechanical part 22. If there were already two faulty measurements at this stage, the pressure allocation unit 26 skips this stage and replaces it with an error message in the storage unit 27. If the measurement at the stage „p_{i-1}" was successful, the pressure allocation unit 26 checks the monotone growth of results of three last measurements $\underline{a}_i$, $\underline{a}_{i-1}$, $\underline{a}_{i-2}$ in the systolic range and monotone diminution thereof in the diastolic range. If two higher values surround a lower one instead, the pressure allocation unit 26 chooses the pressure „p_i" of the earliest result from the storage unit 27 and allocates it as next pressure to controller of mechanical part 22. The controller of mechanical part 22 diminishes gradually the pressure in cuff 11 by control of discharge valve 13. If growth of pressure is required, the motor-driven pump 12 is used. If the check of „triplet" of amplitudes shows a higher value between lower ones, the measurement steps from the systolic range into diastolic one, i. e. into range of diminishing values of $\underline{a}$. The duration of measurement must not surpass two minutes, with all required repetitions included, otherwise the program controller 21 puts an error message into storage unit 27 and terminates the incomplete measurement. As the dimensions of used cuff 11 influences the time required to reach the start pressure, the program controller 21 makes a correction to the duration of to minutes. The supervising unit 31 allocates however at most 3 minutes for safety valve 15 and then it opens automatically the safety valve 15, so no longer measurement is allowed. The motor of motor-driven pump 12 works generally at a medium speed for the sake of silent operation, but in some cases when a return to higher pressure is required, the speed of motor should be higher because of the time limit of measurement, which can be accompanied with a higher noise.

After completion of measurement the arithmetical unit evaluates the series of pairs „p_i" and $\underline{a}_i$ using the above mentioned approximation with parabola. The values of p_s and p_d are acceptable if the point determined by a pair of values is within a defined range on the diagram $p_d - p_s$. This range is advantageously in the area bordered with straight lines

$p_s = 1.9p_d+90$; p_s =305; p = 205; $p_s = p_d+5$; p_s =40; and p_d =25.

If a pair of values is calculated on the basis of measurement, and it is outside of this area, it cannot be accepted to the evaluation of a complete series of measurements of 24 or 48 hours.

The time required to a measurement depends on the blood pressure and movements of patient. It takes 30 to 40 seconds for a patient of average blood pressure and good cooperation. The apparatus tries to accomplish a measurement at most during 120 seconds by reasons of safety. If the measurement does not succeed during this time, it diminishes quickly the pression and returns to stationary state. A characteristic feature of a successful measurement is, that the pressure diminishes in quick steps and then the apparatus reduces the pressure to zero. The measured values are stored in the storage unit and can be also read on display. The apparatus displays a result of programmed measurement twice, that of manually started measurement six times, then it returns to stationary state and waits next point of time or a request by depressed button. In this moment the actual time appears on the display.

An advantageous embodiment of the apparatus according to invention is equipped with an airbag 16 between motor-driven pump 12 and cuff 11 in the pneumatic system, which means, that this airbag is included between motor-driven pump 12 and pressure sensor 14. The result of this simple solution is, that the vibration of motor-driven pump 12 does not influence the pressure sensor 14 because it is damped in the airbag 16. In consequence, the oscillation of impulses can be measured very well even during increase of pressure in cuff 11. As this advantage was recognized, the blood pressure measurement becomes simpler and shorter using this embodiment of the apparatus according to invention. The pressure stages can be measured twice along the enveloping parabola: first time when the pressure increases in cuff 11 and second time when it diminishes. The two passes in opposite directions enable a good control, so the control of measured „triplets" in each stage and the following multiple returns to previous pressure stages become unnecessary. The

measurement becomes completely patient-friendly. The prolongation of measurement time and all uncomfortable feelings cease, which were caused by repetition of measures.

The solution according to invention is a new combination of partial solutions which were known in themselves, and it results in an intelligent blood pressure measuring apparatus which is extraordinarily simple, it is cheap at the same time, applicable for mass-production and suitable for multiple purposes. The apparatus represents a new solution in comparison to the state of art, either in portable embodiment for 24 hours long measurement or in one for home (IC) measurements.

The apparatus is a „professional" device owing to its structure, which can give results of examinations equivalent to sophisticated and expensive clinical measuring instruments of high exigencies.

The possibility, that the patient can use the apparatus in his own home for long time, enables to eliminate the „effect of white cloak" usual in clinics and as consequence, it eliminates the false diagnoses of hypertension, which represent a redundancy of 25 %. The intensive control (IC) performed by the patient himself according to signals of apparatus in home environment provides the physician with indispensable information about the effectiveness of medicament taken and contains less faulty data than measurements performed during movement. The electronic structure of apparatus enables to accomplish a series of measurement with duration of several weeks, which enables to evaluate the effectiveness of medicament as near to reality as never before. The apparatus ensures to take medicaments according to physician's program and measures blood pressure in accordance with taking medicaments. The physician receives results of measurement in a processed form, so the workload of clinical computer becomes shorter. A physician's software can be supplied to the apparatus, which provides the physician with a „report" with an evaluation of results supplied by the apparatus in words. If an applicable data

communication line exists, the apparatus is capable to transfer results of measurements continuously to the computer of clinical domain.

A preferable embodiment of the apparatus makes the shortened cycle of measurement even simpler and shorter by elimination of circuits (returns) while the measurements are performed during passing of pressure stages.

Claims

1. A blood pressure measuring apparatus applicable to control and register blood pressure during 24 hours or for longer period of time, the mechanic part of said apparatus consists of a measuring cuff, a motor-driven pump, a pressure sensor, a discharge valve and a security valve, all are pneumatically connected, an electronic part electrically connected with controlling connections to the motor-driven pump, discharge valve and the safety valve and a sensing connection to the output of pressure sensor, characterized by that it contains a program controller (21) and a supervising unit (31), a controller of mechanical part (22), a signal receiving and processing unit (23), a storage unit (27), an evaluating unit (24), an arithmetic unit and a pressure allocating unit are connected to the program controller (21), and an internal clock (32), a power supply unit of clock (33) and optionally an event display (34) are connected to the supervising unit (31).

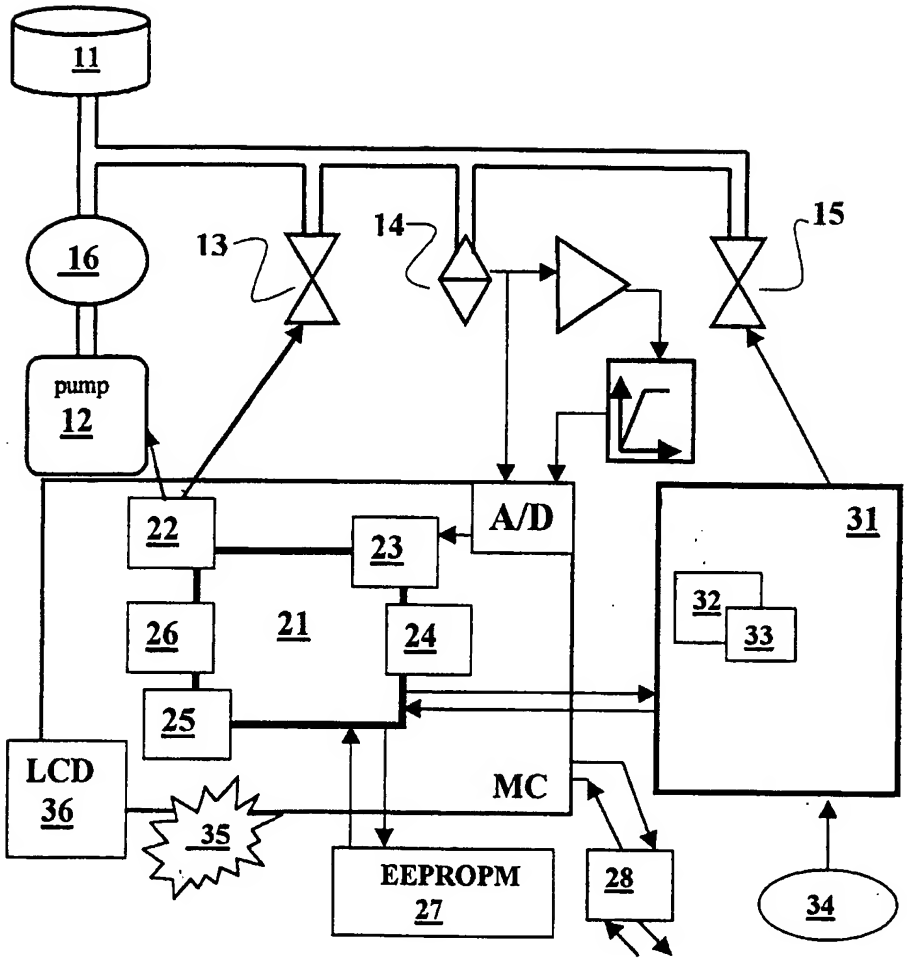
2. The apparatus according to Claim 1, characterized by that the program controller (21), controller of mechanical part (22), signal receiving and processing unit (23) evaluating unit (24) arithmetic unit (25) and pressure allocating unit (26) are advantageously embodied in a common micro-controller.

3. The apparatus according to Claims 1 or 2, characterized by that an airbag (16) acting as buffer is included into pneumatic system between the motor-driven pump (12) and cuff (11).

4. The apparatus according to any of Claims 1 to 3, characterized by that it is equipped with a multifunction event display (34).

5. The apparatus according to any of Claims 1 to 4, characterized by that it is equipped with a LCD display (34) and/or a sound signaling device (35).

6. The apparatus according to any of Claims 1 to 4, characterized by that an automatic voltage control unit is built into apparatus.


11
16
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MC
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EEPROPM
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Figure 1

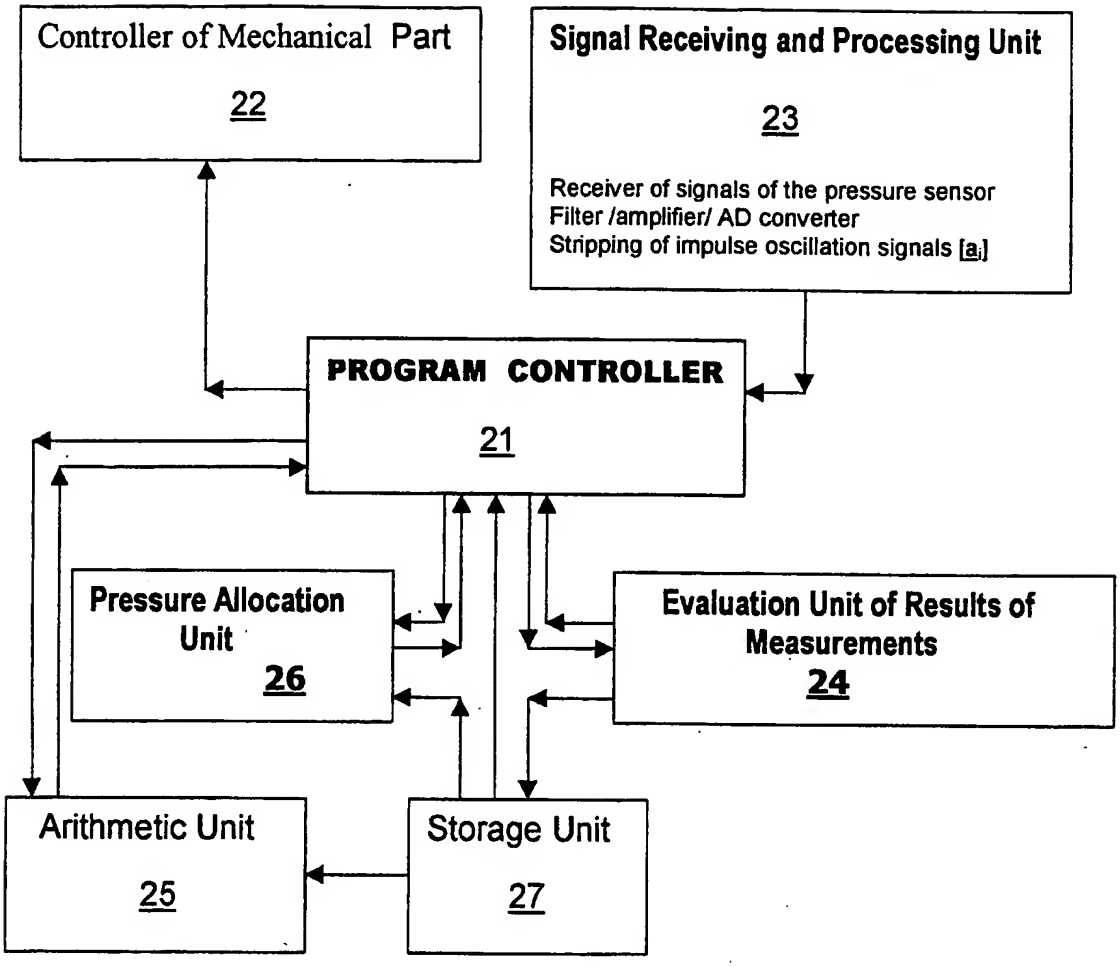
Controller of Mechanical Part
22
Signal Receiving and Processing Unit
23
Receiver of signals of the pressure sensor
Filter /amplifier/ AD converter
Stripping of impulse oscillation signals [a_i]
PROGRAM CONTROLLER
21
Pressure Allocation Unit
26
Evaluation Unit of Results of Measurements
24
Arithmetic Unit
25
Storage Unit
27

Figure 2

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/HU 00/00121

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B5/022

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 094 244 A (CALLAHAN WAYNE ET AL) 10 March 1992 (1992-03-10) column 6, line 20 -column 7, line 58 figure 2 ---	1-3 4,6
X	US 4 617 937 A (MOCZYGEMBA MARK E ET AL) 21 October 1986 (1986-10-21) column 3, line 26 - line 48 column 4, line 7 - line 61 figure 2 ---	1,2,5
Y A	US 5 485 848 A (JACKSON HARRY E ET AL) 23 January 1996 (1996-01-23) column 5, line 35 - line 59 column 11, line 5 - line 17 --- -/--	4 1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
14 March 2001	21/03/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Martelli, L

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INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/HU 00/00121

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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